SINUS PENTA

MULTIFUNCTION AC DRIVE

USER MANUAL

BACNet Programming Instructions-

Upd. 27/10/2008
R. 01
VER. SW 1.66x

English

• This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
• This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
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• Any changes to the structure or operating cycle of the device must be performed or authorized by the Engineering Department of Elettronica Santerno.
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1. BACNET FIELDBUS COMMUNICATIONS BOARD

BACnet is a data communication protocol specifically designed for building automation and control systems. Building automation systems (or building management systems) using BACnet incorporate a wide variety of applications and components into the one system. The applications cover heating, ventilation and air conditioning (HVAC), power monitoring, lighting control, access control and fire alarms for the entire building.

Developed under the guidance of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), BACnet is an American national standard, a European standard, a national standard in more than 30 countries and an ISO global standard.

The BACnet communications board allows interfacing a Sinus PENTA inverter with an external control unit through a communications interface using a BACnet protocol of either BACnet IP or BACnet MSTP.

The user configuration software allows the setting of global Node ID and Network Number in addition to configuration of IP address and Subnet mask to suit BACnet IP using the Ethernet protocol and System Node, Baud rate, party, data bits and stop bits for BACnet MSTP using the RS485 protocol.

For the purposes of this manual, A BACnet device can be considered to be a piece of hardware such as a Sinus Penta drive. Each BACnet device will have a number of associated BACnet Objects, corresponding to parameters, measurements, and the like. In this application, the Sinus Penta Drive has a minimum of 13 objects of the 'Analogue Value' type for communicating various parameters between the drive and the BACnet network. This minimum number of objects can be increased to include additional measurements as required by the user.

1.1. BACNET COMMUNICATION CARDS

Two PCB's are provided as part of the Sinus PENTA BACnet fieldbus option:

1. ES919 interface board – plugs into Slot B of the ES821 control card inside the Sinus Penta.

   <PIC OF ES919>

   Once board ES919 is fitted, connector DB9 port/RS-485 installed on the inverter will automatically disable. To use the DB9/RS485 port temporarily to program the drive (e.g using Remote Drive) simply toggle the DIP switches SW1 on the ES919 to enable/disable. The RJ45 keypad/modbus port is unaffected by the addition of the ES919.

   To install the ES919:
   - Turn off the inverter and wait 5 minutes for the DC bus capacitors to discharge
   - Remove the front cover allowing access to the expansion ports on the ES821 control card
   - Fit ES919 ensuring that all contacts enter the relevant housing in the signal connector
   - Configure DIP switches as described above

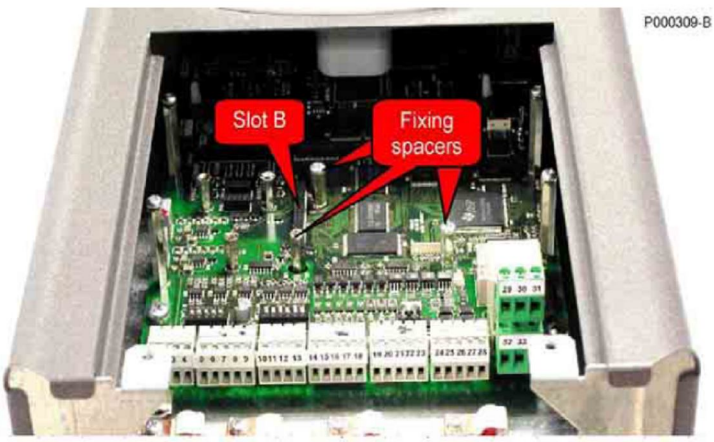

Figure 1 - Location of the mounting position of ES919

2. BACnet Fieldbus PCB – plugs into the ES919 in one of two configurations depending upon whether BACnet IP or BACnet MSTP is to be used to allow easy cable entry into the fieldbus card.

Figure 2 - BACnet Fieldbus Communications Card

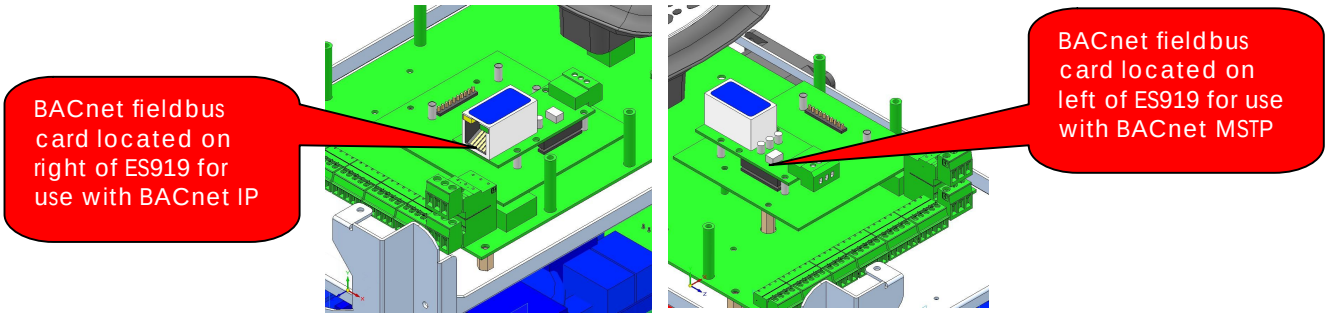

Figure 3 – BACnet fieldbus card installed on the ES919

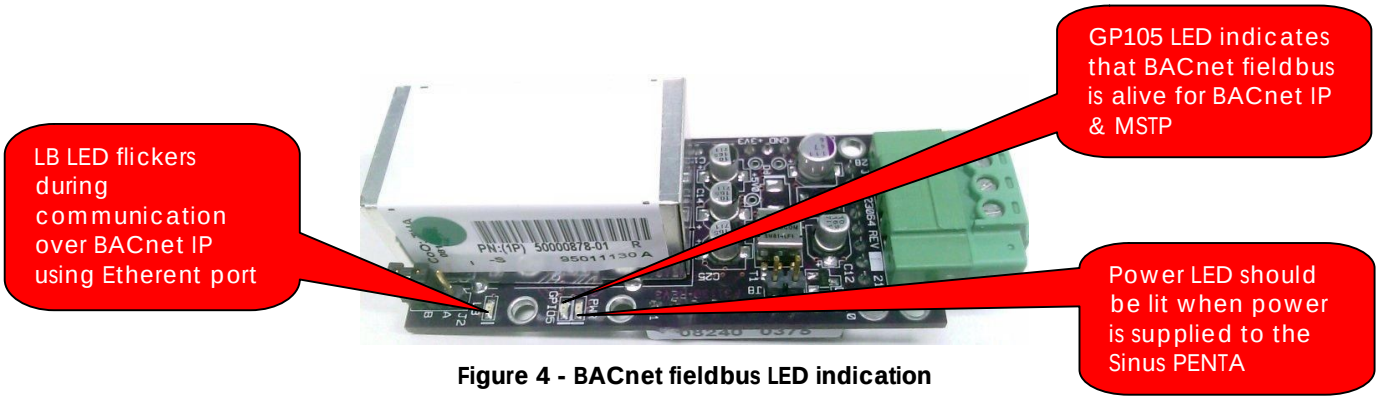

Figure 4 - BACnet fieldbus LED indication

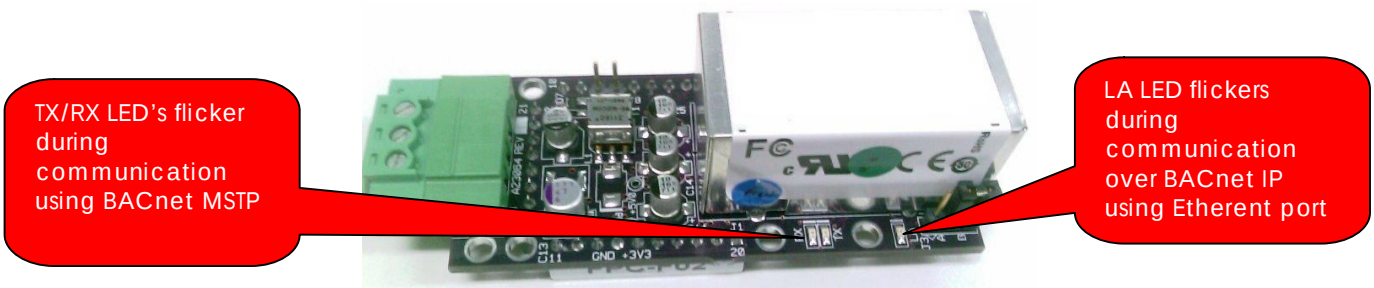

Figure 5 - BACnet fieldbus LED indication

1.2. BACNET FIELDBUS TERMINALS

1.2.1. BACNET IP

BACnet IP is a popular international LAN standard widely deployed in commercial applications using the Ethernet communication medium. In addition, BACnet IP devices can take advantage of the Internet and Internet based technologies.

Ethernet is fast, running from 10 Mbit/s to 10Gbit/s, and runs on a variety of media-STP, coaxial cable, or fiber optics. Using BACnet IP will allow standard Ethernet based hardware right up to the end node device – such as a Santerno VSD. BACnet IP is the latest version of BACnet to be released and is quickly growing in popularity due to its fast data transfer speed and use of inexpensive and readily available Ethernet hardware.

The Ethernet interface is a cable bus which runs over copper or fiber. The copper interfaces use either a coax line or differential twisted pairs, while the fiber runs use fiber-optic cables. The Ethernet network is defined by IEEE 802.3

The Ethernet standard uses Manchester Encoding and Decoding. Access control is gained via Carrier Sense, Multiple Access with Collision Detect (CSMA_CD). Preamble Field: A 56 bit pattern of alternating ones and zeros which are used to synchronize the receiver clock to the incoming data packet. SFD Field: Start Frame Delimiter Field, indicates the beginning of the frame; [10101011].

Typical Ethernet packet is shown below:

The board is provided with a standard RJ-45 connector (IEEE 802) for Ethernet connection 10/100 (100Base-TX, 10Base-T). The pin arrangement is the same as the one used for each network board computers are equipped with.

Pin arrangement:

N.	*Name*	*Description*
1	TD+	Positive signal transmission line
2	TD-	Negative signal transmission line
3	RD+	Line receiving positive signals
4	Term	Terminated pair – not used
5	Term	Terminated pair – not used
6	RD-	Line receiving negative signals
7	Term	Terminated pair – not used
8	Term	Terminated pair – not used

1.2.2. BACNET MSTP

BACnet MSTP uses the EIA-485 signalling standard. This is a shielded twisted-pair (STP) LAN operating at speeds from 9.6 kbit/s to 76.8 kbit/s. This LAN type is low cost and particularly suitable for unitary controller communications.

EIA-485 (formerly RS-485 or RS485) is an electrical specification of a two-wire,[1] half-duplex, multipoint serial communications channel. Since it uses a differential balanced line over twisted pair (like EIA-422), it can span relatively large distances (up to 1,200 m).

This standard is now administered by the TIA and is titled TIA-485-A Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems (ANSI/TIA/EIA-485-A-98).

EIA-485 signalling standard specifies the following:

Type of cable	Screened cable composed of balanced D1/D0 pair + common conductor ("Common")
Min. cross-section of conductors	AWG24 corresponding to 0.25 sq mm. For long cable length, larger cross-sections up to 0.75 sq mm are recommended.
Max. length	1000 metres based on the max. distance between two stations
Characteristic impedance	Better if exceeding 100Ω (120Ω is typically recommended)
Standard colours	Yellow/brown for D1/D0 pair, grey for "Common" signal

Pin configurations for the BACnet MSTP fieldbus card are as follows:

PIN	FUNCTION
+	(TX/RX A) Differential input/output A (bidirectional) according to standard EIA-485. Positive polarity with respect to + for one MARK.
-	(TX/RX B) Differential input/output B (bidirectional) according to standard EIA-485. Negative polarity with respect to - for one MARK.
G	(GND) control board zero volt. Common according to EIA-485 association.

1.3. BACNET CONFIGURATION SOFTWARE

The BACnet fieldbus communication kit contains BACnet configuration software. This software allows the user to set parameters for a specific BACnet installation

After installation, run 'Sinus Penta BACnet configurator.exe' which will load the BACnet configuration software.

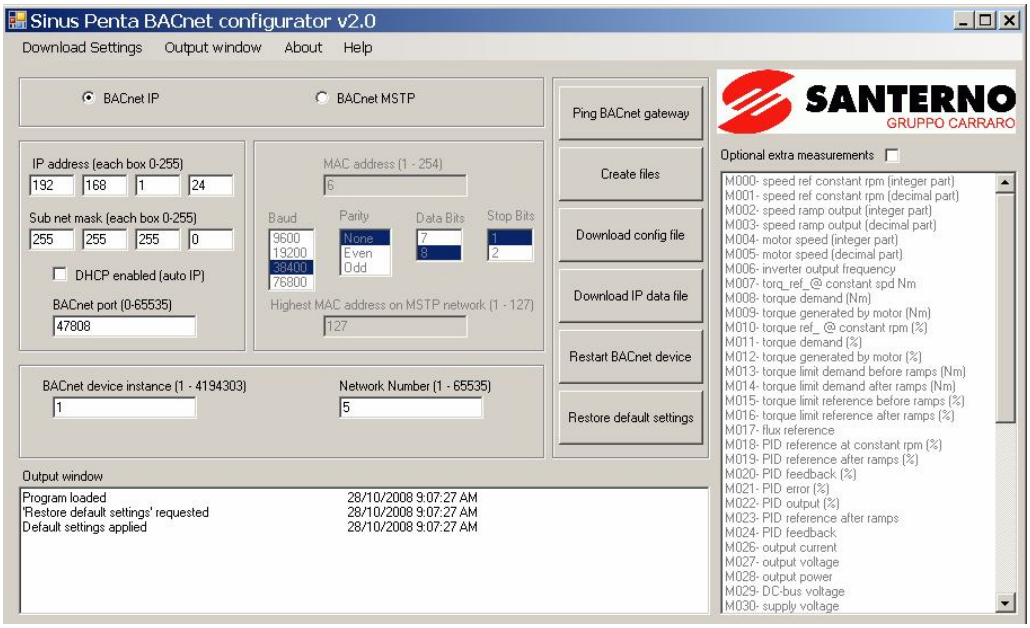

Figure 6 - BACnet Configuration Software

To configure and download the settings follow the steps below:

1. Set up a connection on IP address 192.168.1.X from the host PC (Default IP address of the BACnet fieldbus card is 192.168.1.24)
2. Connect the host PC to the BACnet device using an ethernet crossover cable or straight through cable if connecting from a Hub/Switch.
3. Ping the BACnet device using the 'Ping BACnet gateway' button within the BACnet configurator software to ensure communication has been achieved. A command window will appear, containing the IP address of any BACnet fieldbus devices that the host PC can detect.
4. Select your choice of BACnet IP or BACnet MSTP within the BACnet configuration software
5. For BACnet IP, enter a desired IP address, Subnet mask and BACnet port, and select DHCP if required
6. For BACnet MSTP, enter the MAC address, baud rate, parity, # stop bits, # data bits and highest MAC address on the network
7. Enter the BACnet device instance and the Network Number
8. By selecting the 'Optional extra measurements' checkbox, you can select from a range of measure parameters which can be transmitted from the Sinus PENTA over the BACnet fieldbus. See next section for details on the layout of the data received over the fieldbus.
9. Click on 'Create Files'
10. Click on 'Download config file' to configure the BACnet fieldbus network card
11. Click on 'Download IP data file' to configure the BACnet fieldbus network card (BACnet IP only)
12. Click on 'Restart BACnet Device' after the download has completed.

NOTE: BACnet fieldbus card is back on-line once the 'GP105' LED begins flashing again located next the Ethernet socket.

13. To restore default settings, click on 'Restore Defaults'.

NOTE: The Output Window will detail all processes undertaken by the user

2. EXCHANGED PARAMETERS

The tables below shows the Sinus Penta parameters exchanged via BACnet fieldbus.

Each table contains:
1) the parameter code;
2) its description;
3) its range;
4) its unit of measure (also indicated on the display);

N.B.: each parameter is exchanged as a 32 bit floating point number, using the IEEE 754 standard

It is assumed that for BACnet operation where the speed reference and digitial control is via the BACnet fieldbus, **C143** ÷ **C146** is set as 5:Serial Link for correct operation. For PID control where the reference (setpoint) and feedback is sent over the BACnet fieldbus, it is assumed that **C285** ÷ **C290** is set to 5:Serial Link.

FROM BACNET NETWORK TO SINUS PENTA

Analogue Value Object	1) Code	2) Description	3) Range	4) Unit of Measure
1	M035	Digital Inputs from FIELD BUS	–	-
2	M042	Speed reference from FIELD BUS (integer portion)	– 32000 ÷ + 32000	rpm
3	M043	Speed reference from FIELD BUS (decimal portion)	– 0.99 ÷ + 0.99	rpm
4	M045	Torque reference/ Torque limit	– 500 ÷ + 500	%
5	M047	PID Reference	– 100 ÷ + 100	%
6	M048	PID Feedback	– 100 ÷ + 100	%

Object 1: digital inputs from field bus
The virtual digital inputs via the Fieldbus are the low byte of the element. To read the virtual digital inputs, convert the value read in object 6 as a decimal integer into a 16-bit binary number. The eight least significant bits (1-8) correspond with Digital Inputs 1 to 8.

For example, if the number received in this object was '71':
71_{10} = 00000000 01000111_0
The least significant bits are on the right hand side, 01000111
From this: Input 1 = ON
Input 2 = ON
Input 3 = ON
Input 4 = OFF
Input 5 = OFF
Input 6 = OFF
Input 7 = ON
Input 8 = OFF

Analogue Value Object 1								
MDI1	MDI2	MDI3	MDI4	MDI5	MDI6	MDI7	MDI8	

The logic status of these bits is included in the overall status of the inverter digital inputs (measure **M031**).

Object 2: Speed Reference (Integer Portion)
Object 2 of the memory map details the integer portion of the speed reference (M042) in either IFD, VTC or FOC mode.

Object 3: Speed Reference (Decimal Portion)
Object 3 details the decimal portion of the speed reference (M043) ONLY IN FOC MODE. The value written at the SCADA end will be between -0.99 and +0.99

E.g to send a speed reference of XXX.50rpm, then element 2 must contain the value 0.50_{10}

Object 4: Torque reference/torque limit
The torque reference/torque limit position (M045) is defined as a 'Torque Reference' when the type of reference of the active motor (parameters **C011/C054/C097**) is set as 1:Torque (IFD and VTC modes) or 2:Torque with Speed Limit (FOC).

The torque limit from the FIELD BUS is significant if parameter **C147** is set as 5:Serial Link

Objects 5 and 6: PID reference/feedback
The PID reference (M047) can be sent from the fieldbus if at least one of the parameters **C285** to **C287** is set as 5:Serial Link. The PID feedback (M049) can be sent from the fieldbus if at least one of the parameters **C288** to **C290** is set as 5:Serial Link.

FROM SINUS PENTA TO BACNET NETWORK

Analogue value Object	1) Code	2) Description	3) Range	4) Unit of Measure
7	-	Digital inputs	–	**-**
8	M037	Analog input REF	+/-10V or 0-20mA	V or mA
9	M038	Analog input AIN1	+/-10V or 0-20mA	V or mA
10	M039	Analog input AIN2	+/-10V or 0-20mA	V or mA
11		Digital outputs		
12		Status	-	**As per table**
13		Alarms	-	**As per table**
14...n	Mxxx	Measure Values as selected	As per Mxxx	**Scaled to standard units where appropriate**

Object 7: Digital Inputs
As per Object 1, convert the number to binary, and the eight least significant bits of the number correspond to Digital inputs

Objects 8,9,10: REF, AIN1, AIN2 Analogue Signal
The REF (M037), AIN1 (M038), AIN2 (M039) analogue signals from the Sinus Penta will present as numbers in the range +/-10V or 0-20mA depending upon the selection of **P050, P055, P060**.

Object 11: Digital Outputs
As per Object 1, convert the number to binary, and the **four** least significant bits of the number correspond to Digital inputs

Objects 12 and 13: Status + Alarms
The Objects for Status and alarms will present a number that corresponds to the appropriate table:

The **Status** codes can be found in **Table 103: Status List** of the Programming Manual
The **Alarm** codes can be found in **Table 101: Alarm Codes List** of the Programming Manual

Object 14...x: Mxxx parameters
Using the BACnet configuration software, a selection of Mxxx parameters can be selected to be viewed over the fieldbus. the order of assignment of Measurements from the drive to BACnet objects is based on the order in which they appear in the list of available measures- the top-most selected extra measure will be assigned to object 14, the next one down to 15, and so on.